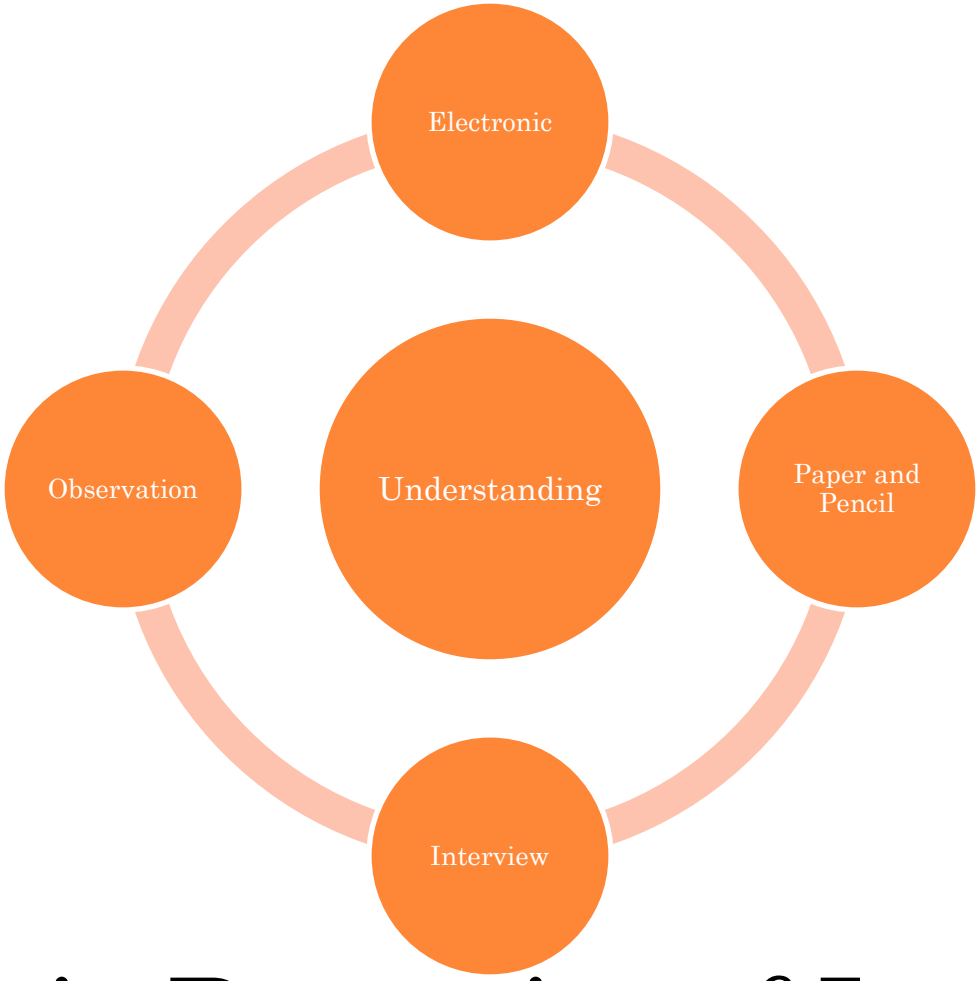
Using Multidimensional Assessments to Build Perspectives on Number Sense

David Woodward
Elementary Math Specialist
Boulder Valley School District, CO

Multidimensional Assessment



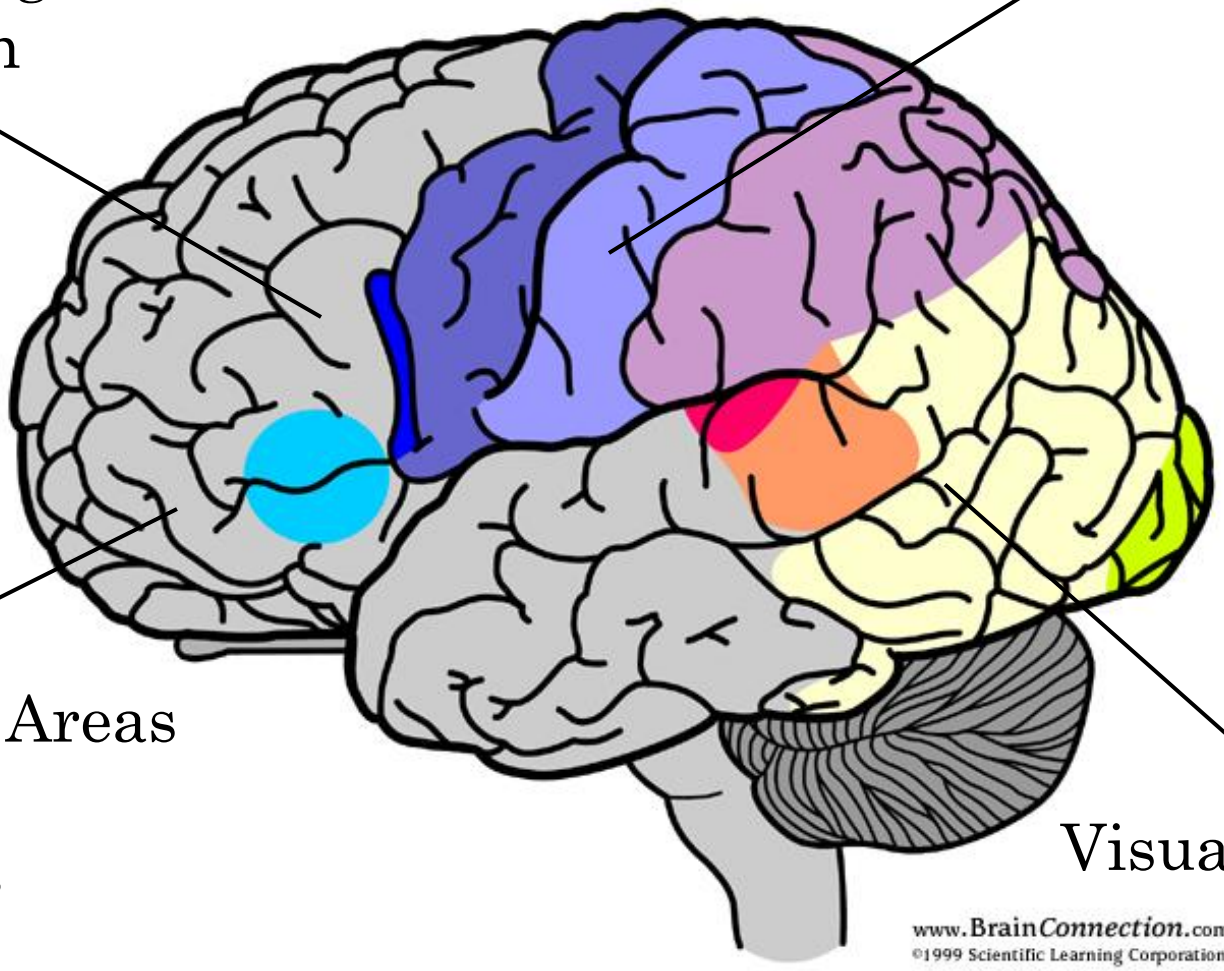
Holistic Portraits of Learning

"A good teacher is an alchemist who gives a fundamentally modular human brain the semblance of an interactive network"

Stanislas Dehaene, 1997

Conceptualization
Strategizing
Integration

Magnitude/Intensity
Subitizing?



Language Areas
Counting
Sequences
Fact
Memorization

Visual/Spatial

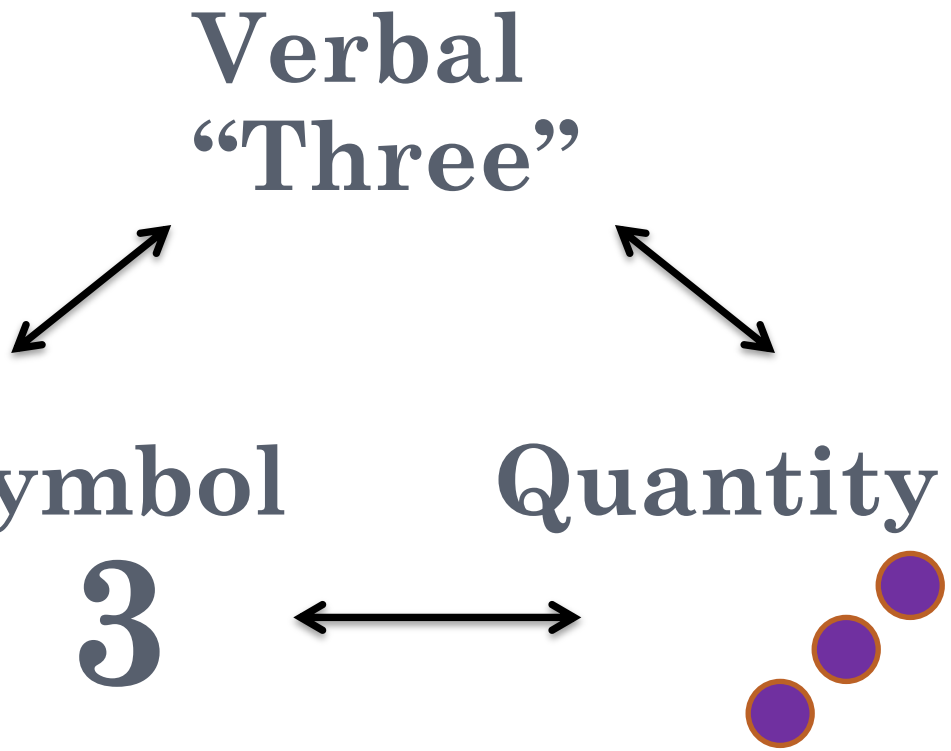
Conflation

when two or more concepts sharing some characteristics seem to become one

To guide and support students' construction of meaning for specific mathematical topics, we must understand how students construct meaning for these topics."

Michael Battista - NCTM 2013

Math Recovery
Add+Vantage Math



The Boulder Valley Number Sense Screeners

- Interview assessments
- 5 minutes per student
- Aligned with the Add+Vantage Math diagnostic assessments.
- Fall assessments for K-5
- Mid and End of Year for K-2
- Aligned with Common Core State Standards

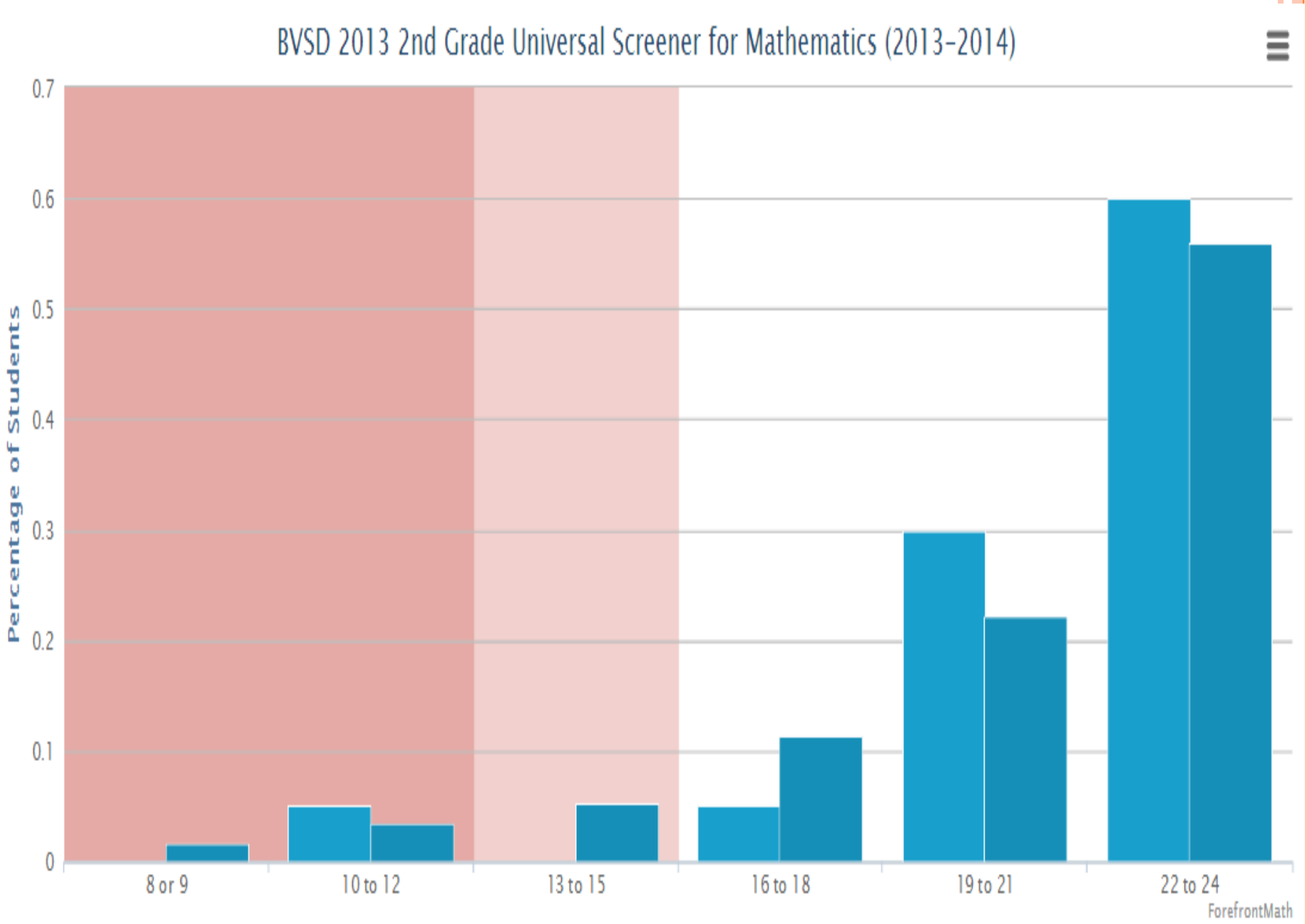
Free and Available: Google BVSD Screeners

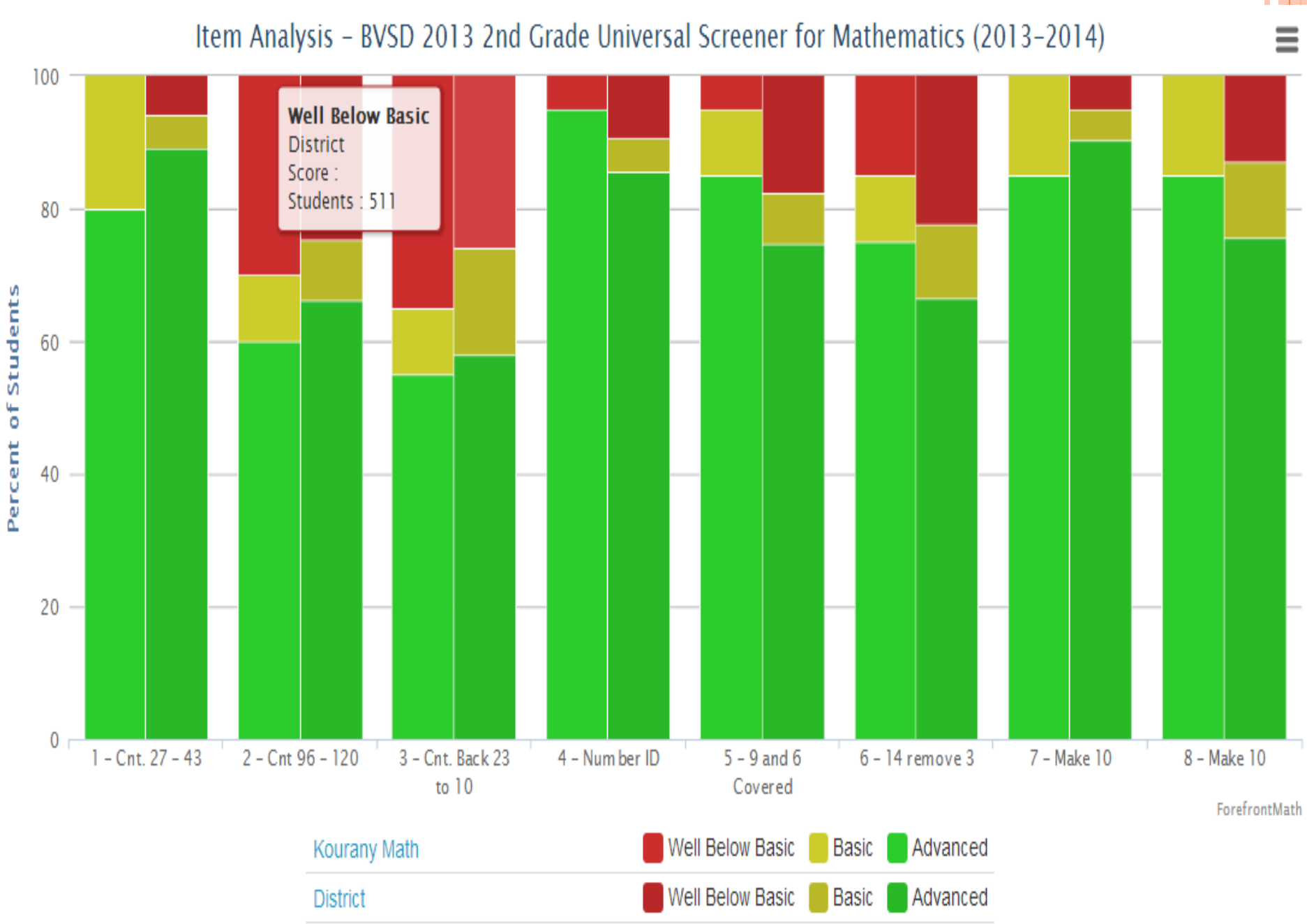
Number Sense Proficiencies

- Magnitude/Estimation
- Fact Recall
- Counting (enumeration)
- Operational Sense (problem solving)
- Place Value

RtI Universal Screeners

- Identify students at risk of struggling
- Zero in on possible areas of struggle
- Inform Tier 1
  - What are the programmatic strengths?
  - What are the ways we need to improve as a school and as a district?


BVSD 2013 2nd Grade Universal Screener for Mathematics (2013-2014)
Percentage of Students
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
8 or 9
10 to 12
13 to 15
16 to 18
19 to 21
22 to 24
ForefrontMath


Item Analysis – BVSD 2013 2nd Grade Universal Screener for Mathematics (2013-2014)
Well Below Basic
District
Score :
Students : 511
Percent of Students
100
80
60
40
20
0
1 – Cnt. 27 – 43
2 – Cnt 96 – 120
3 – Cnt. Back 23 to 10
4 – Number ID
5 – 9 and 6 Covered
6 – 14 remove 3
7 – Make 10
8 – Make 10
ForefrontMath
Kourany Math
Well Below Basic
Basic
Advanced
District
Well Below Basic
Basic
Advanced

“Can they use paper and pencil?”

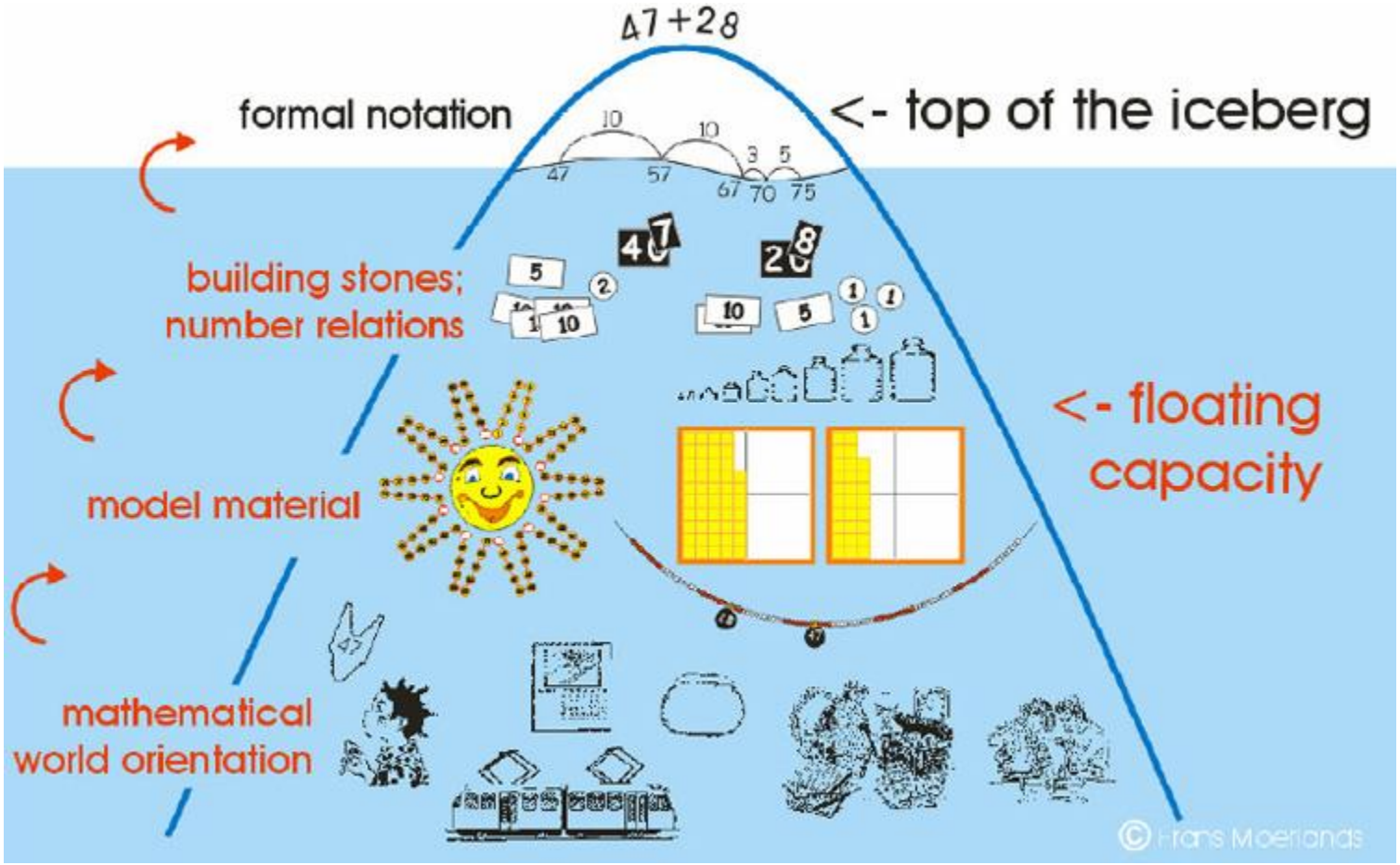
5. Subtract.

53 – 5 =

73 – 40 =

40 – 9 =

The Iceberg Model Freudenthal Institute



Fact Fluency

Add and subtract within 20.

CCSS Math Content 2. OA.B.2

Fluently add and subtract within 20 using mental strategies. By the end of Grade 2 know from memory all sums of two one-digit numbers

1. $3 + 0 =$ 3

2. $5 + 3 =$ 8

3. $6 + 1 =$ 7

4. $12 - 2 =$ 10

5. $8 - 2 =$ 6

6. $14 - 7 =$ 7

7. $9 + 1 =$ 10

8. $6 + 7 =$ 13

9. $11 + 9 =$ 20

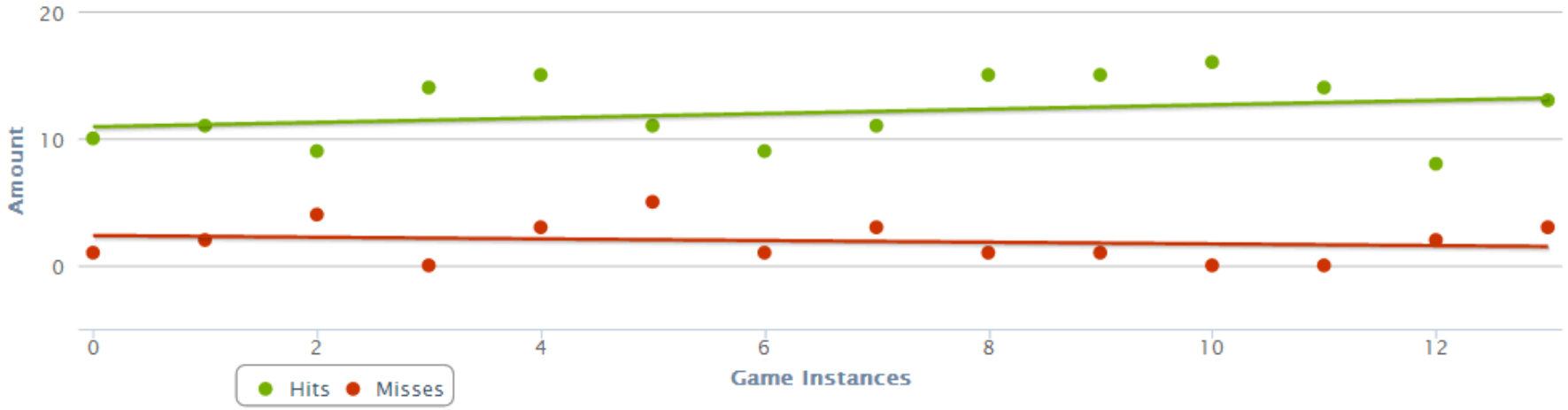
9.

$$\begin{array}{r} 14 \\ -\ 6 \\ \hline 8 \end{array}$$

Arcademic Skill Builders

From 03/01/2014 to 04/11/2014 Apply

Usage | Hits and Misses | Item Analysis



Games Played	Items Answered	Time Spent	Avg. Accuracy	Avg. Rate
14	197	0:13:26	86%	12 /min
			high: 100 low: 68	high: 16 low: 8

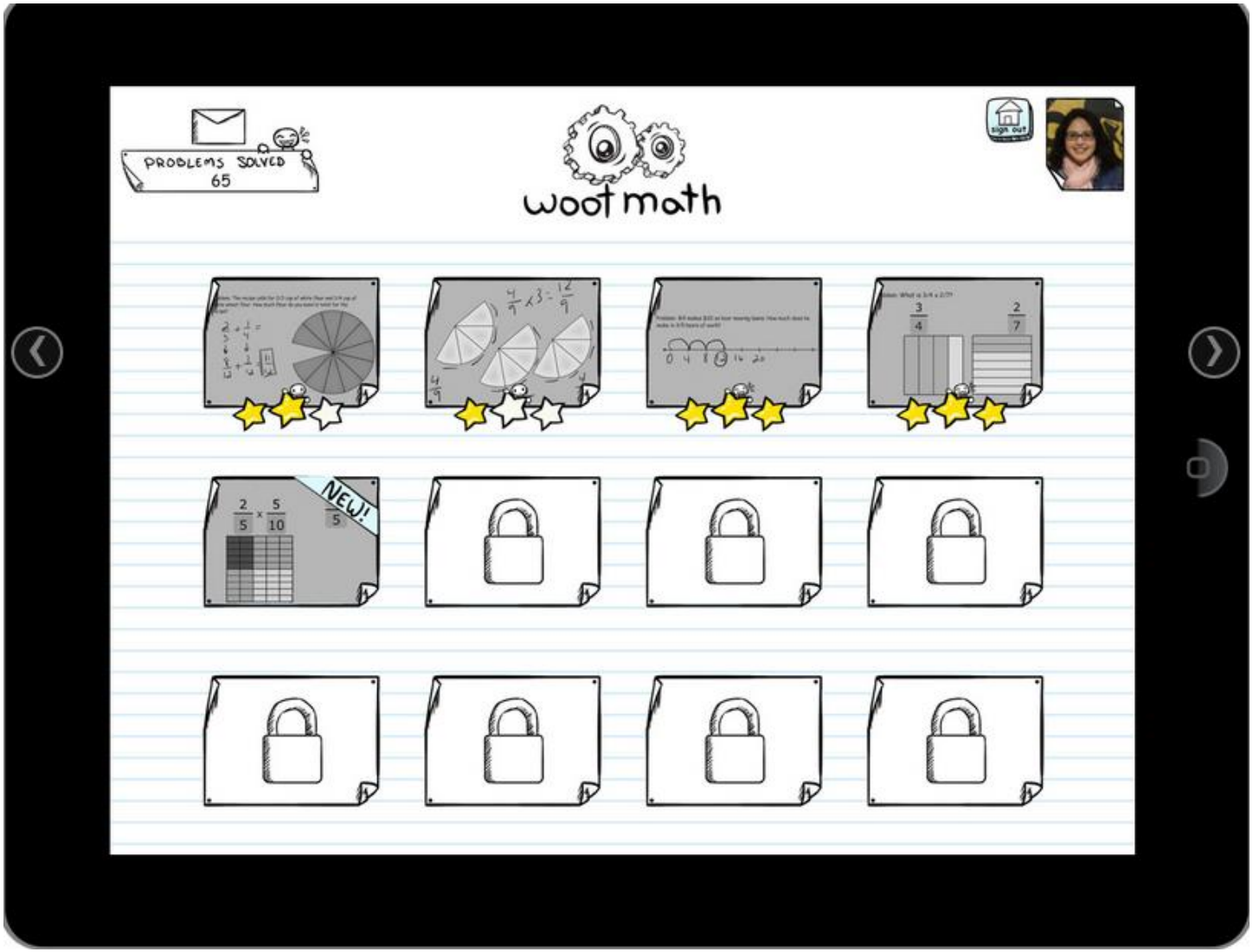
Game Instances

Game Played	Accuracy	Rate	Hits	Misses
1	90%	10/min	10	1
2	84%	11/min	11	2

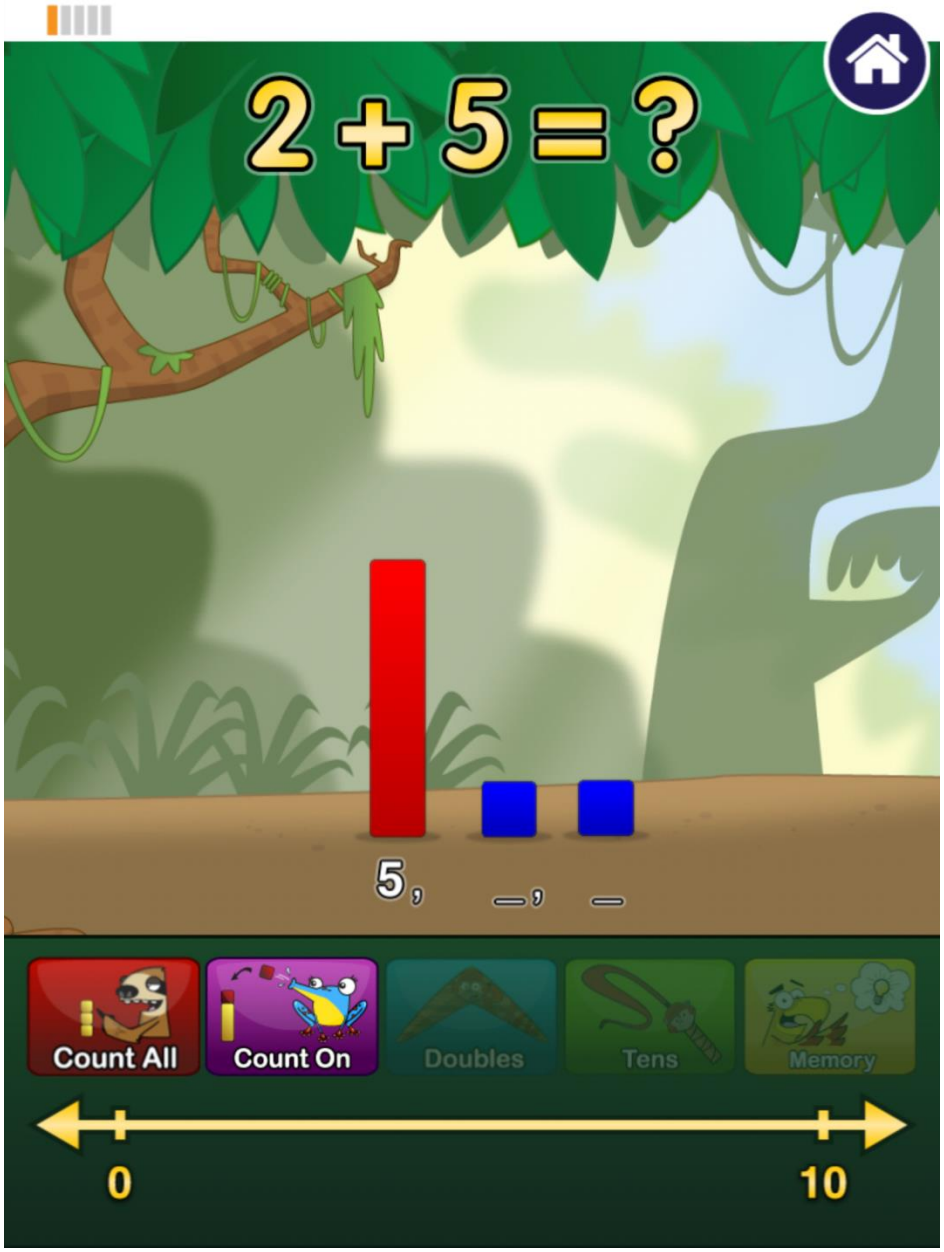
Fact Fluency

- Strategizing (needs observation and interview)
- Rapid recall (needs electronic)
- Contextualizing/applying (needs paper and pencil)
- Generalizing (needs time and all of the above)

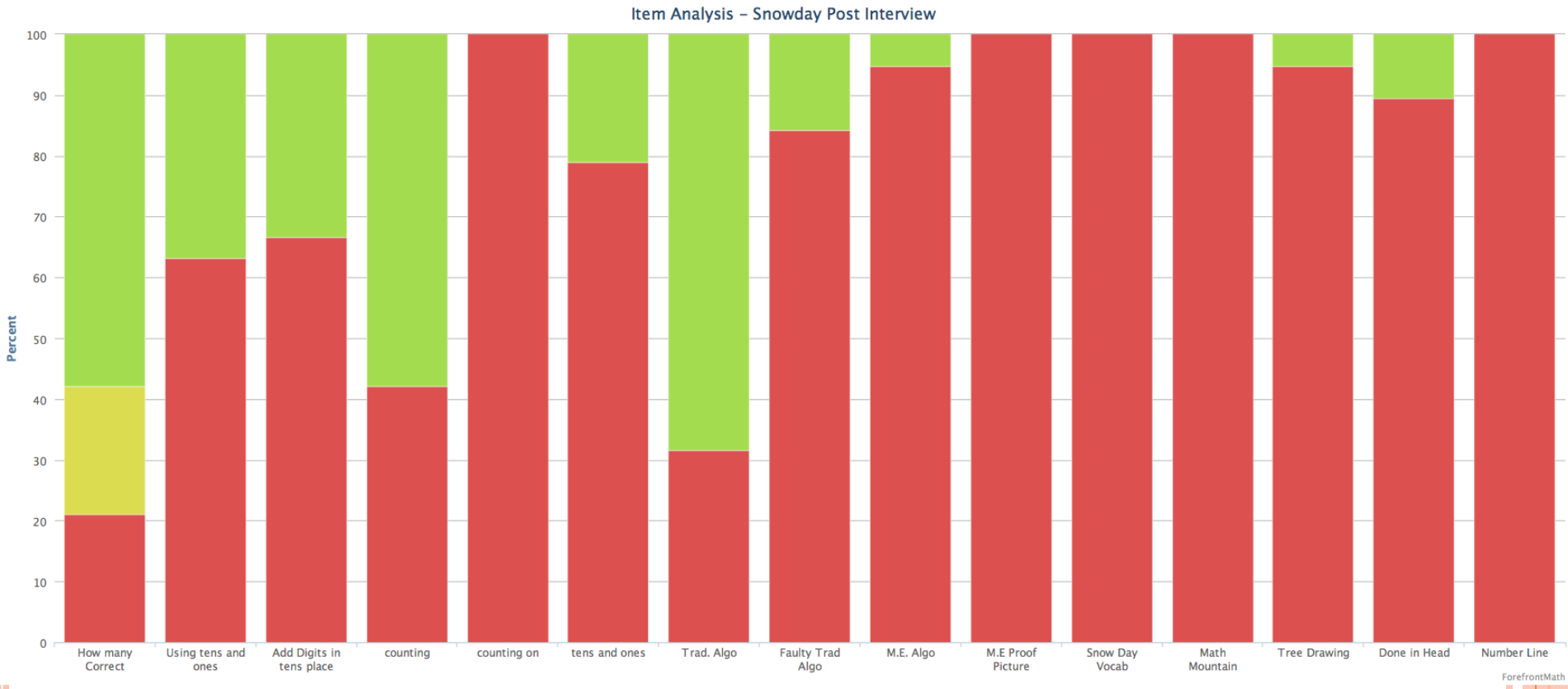
Woot Math – Personalized Fraction



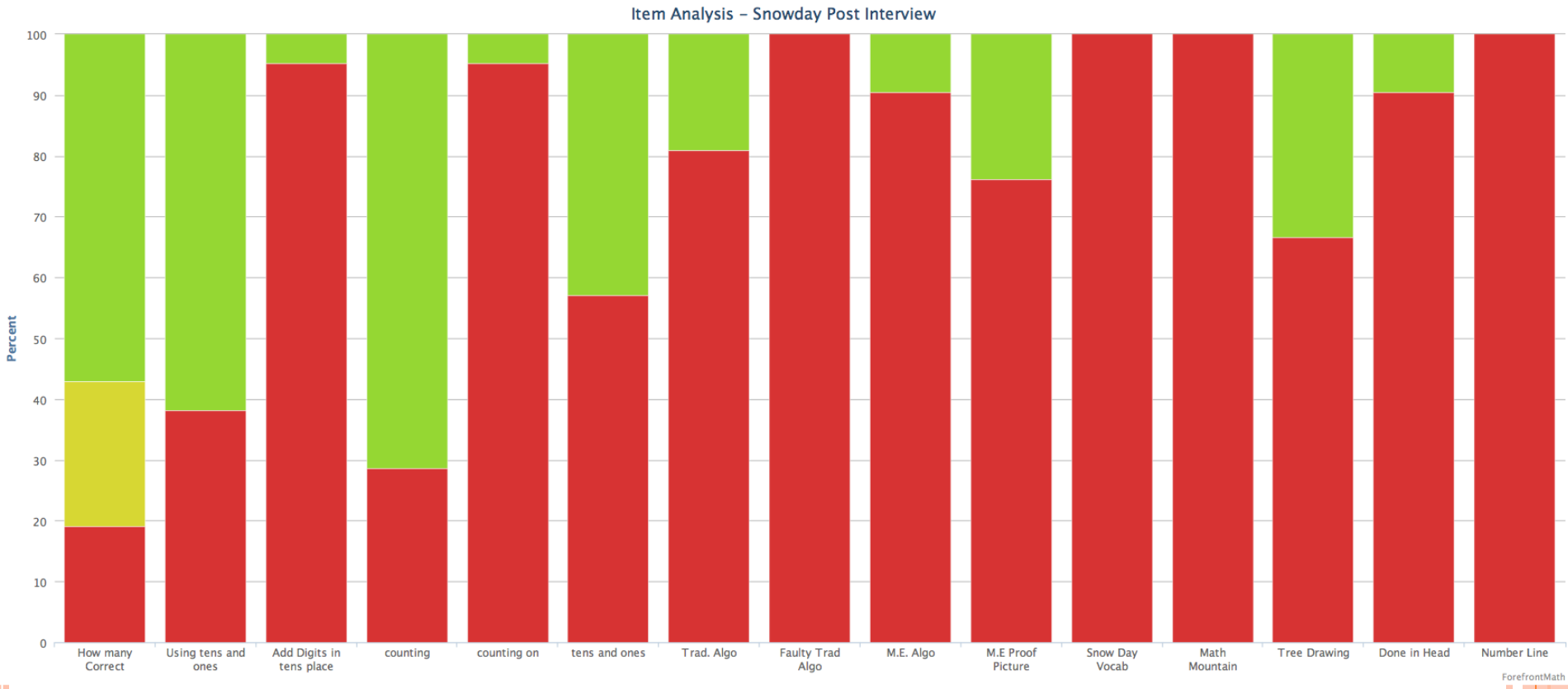
Addimals



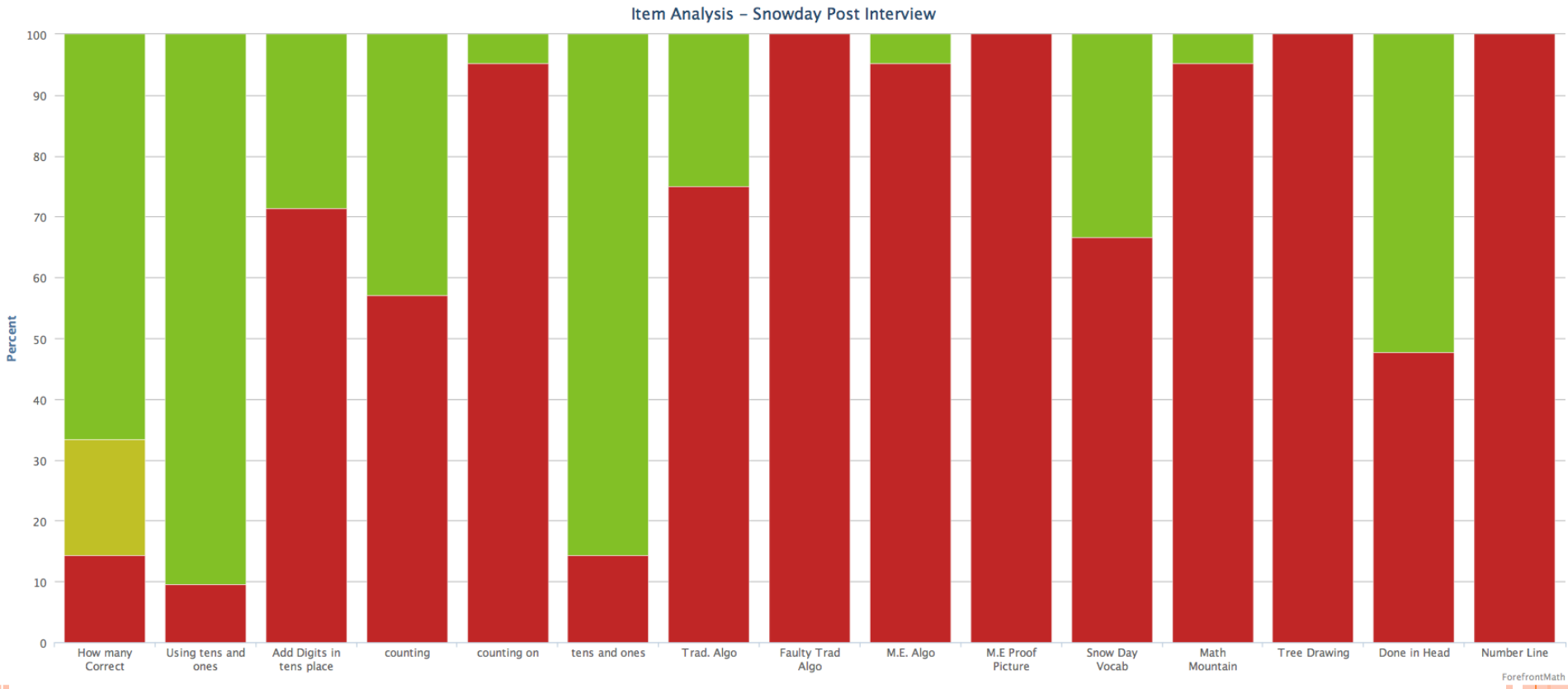
Class One Interview



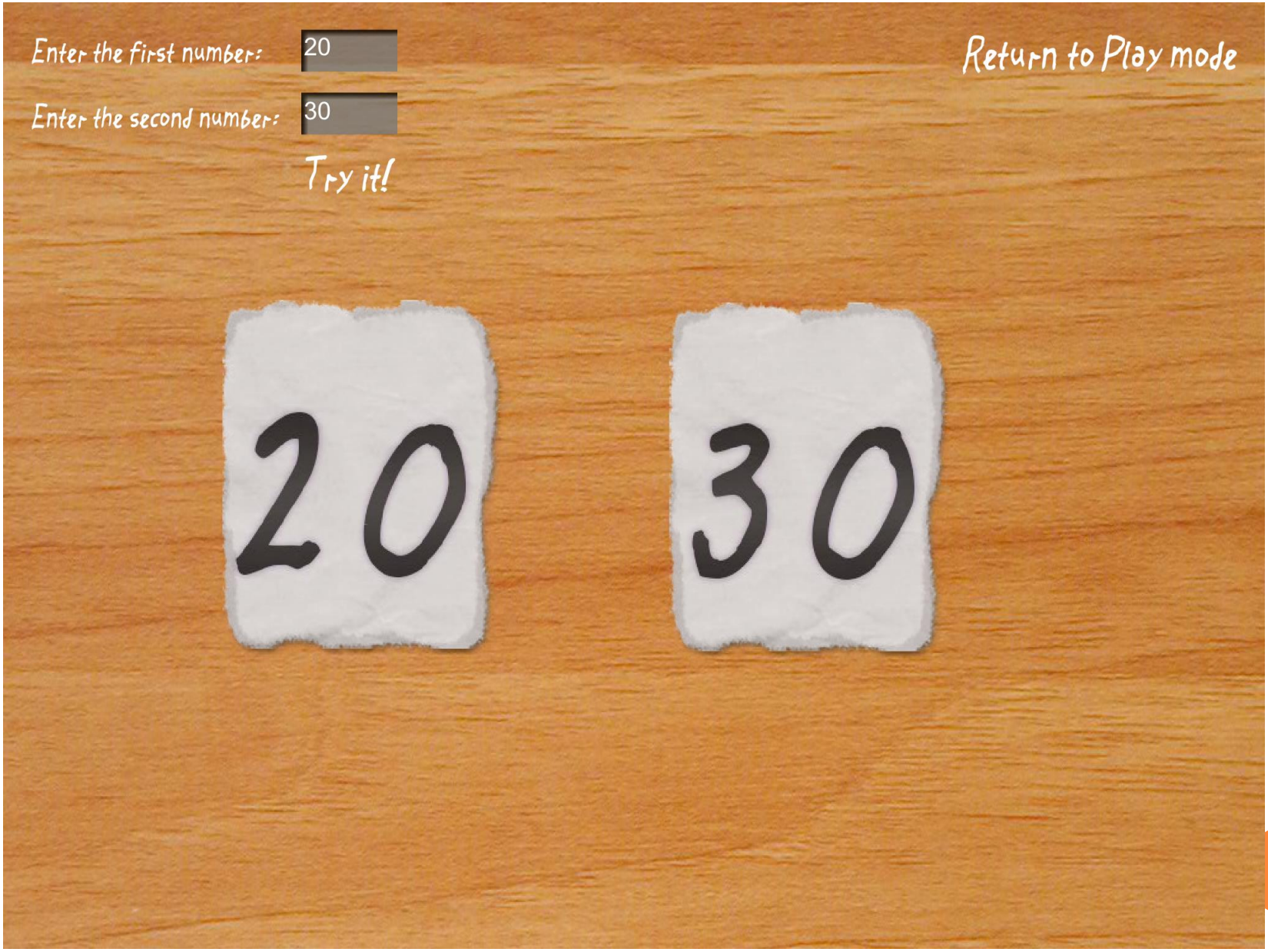
Class Two Interview

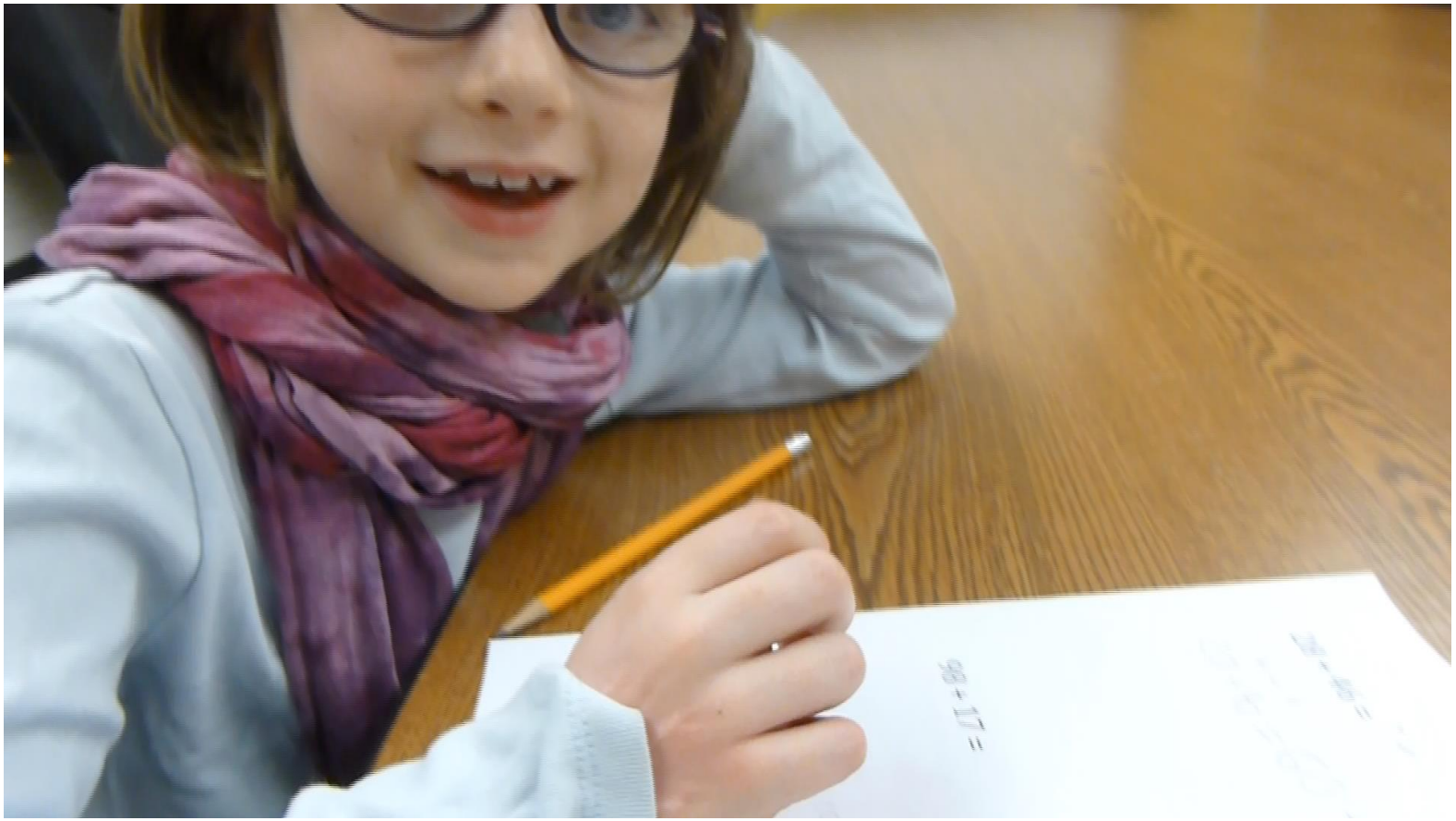


Class Three Interview



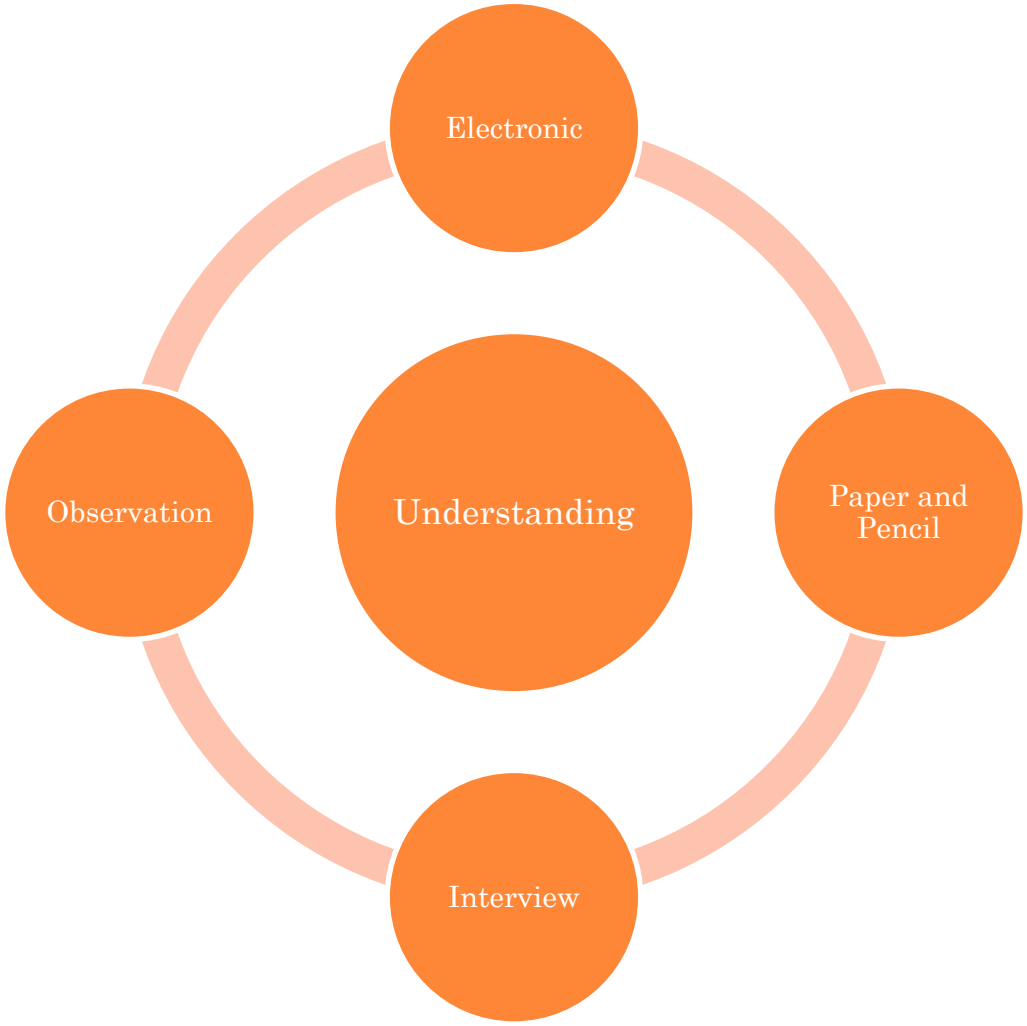
Snowday Math


Enter the first number:
20
Enter the second number:
30
Try it!
Return to Play mode
20
30

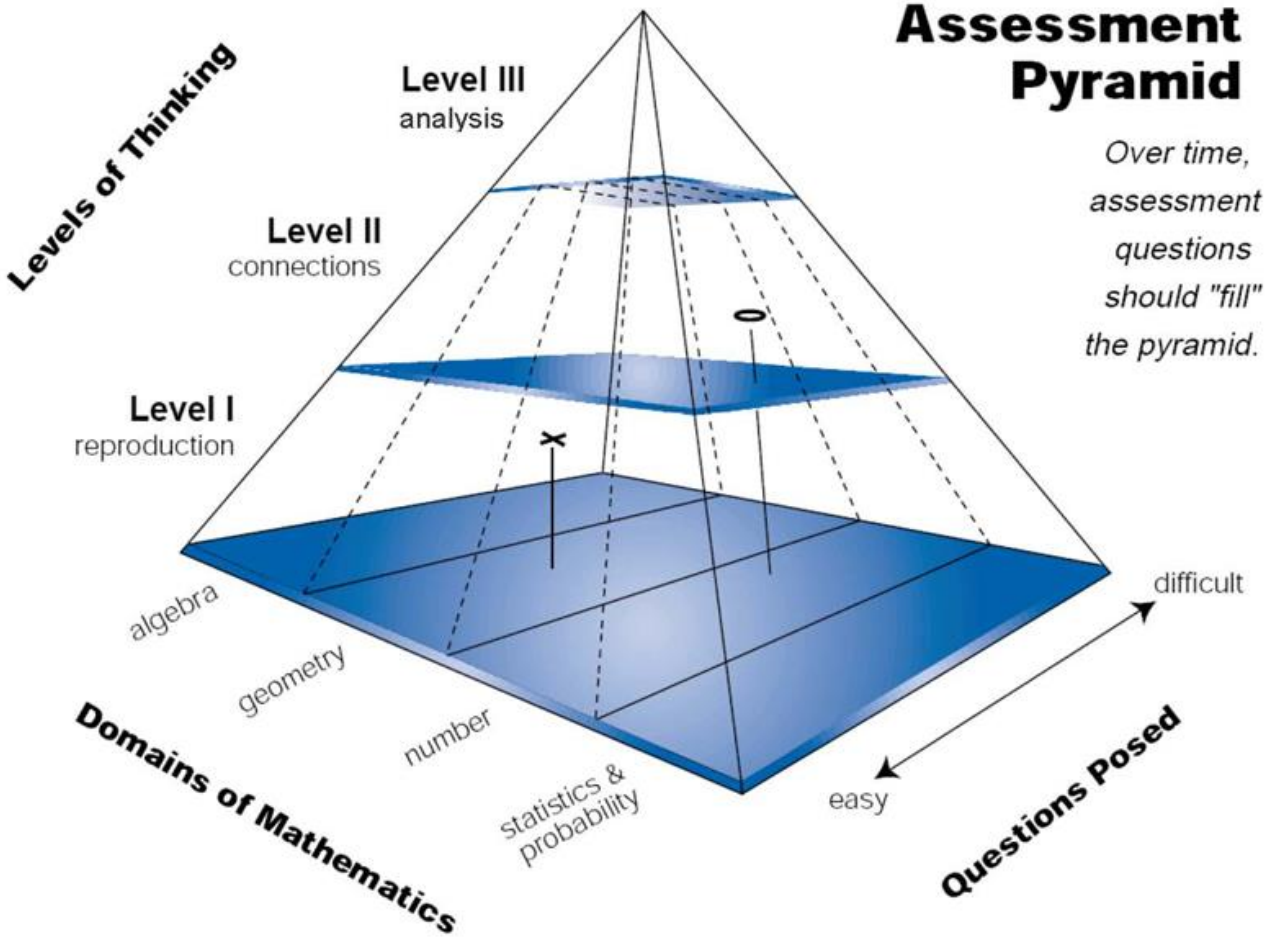

98 + 17 =

When a Ten is not a Ten or Why Electronic Assessments are Not Enough

One Source of Information Can't Paint the Picture



THE
SOAPBOX


Assessment Pyramid
Over time, assessment questions should "fill" the pyramid.
Levels of Thinking
Level III
analysis
Level II
connections
Level I
reproduction
X
O
algebra
geometry
number
statistics & probability
Domains of Mathematics
difficult
easy
Questions Posed

Multidimensional Assessment of CCSSM

Measuring students' understanding of math concepts in this manner offers insight into the robustness of their knowledge, particularly of the Common Core State Standards for Mathematics.

By Sarah K. Bleiler and Denisse R. Thompson

- Teaching Children Mathematics
- December 2012/ Jan.2013

SPUR

- Skills
- Properties
- Uses: Real World Applications
- Representations